Location Systematics

Abstract : Use the multiplicity distributions from data and MC to estimate systematic uncertainty in location analysis

Data

These data taken from Fig.1 (Baller).

Multiplicity	MC	Data	$\delta=(D\text{-}MC)/\sqrt{D}$
1	38	58	2.63
2	80	79	-0.11
3	87	99	1.21
4	97	94	-0.31
5	82	78	-0.45
6	55	68	1.57
7	45	32	-2.30
8	30	18	-2.83
9	16	13	-0.83
>9	20	13	-1.94
	550	552	-3.46

The differences between data and MC are indicated in the table using the statistic δ. The χ^2 from the data, assuming 10 degrees-of-freedom is 29.5/10 = 2.95. The CL is 10^{-3}. The mean multiplicity is 4.56 and 4.19 from MC and data, respectively.

This indicates some significant systematics in the sample of located events. The observed effects are:

- A probable significant excess for $m=1$

- A significant deficit for $m>6$

Neglecting the excess in the first bin, which would alter the normalization, there appears to be approximately 35 events missing from the located sample for $m>6$. Recall that the overall efficiency for location is 579/868 = 0.67 (here only 552 located events are shown). Given the integrated value of ε, the efficiency for the low multiplicity data is $\varepsilon(m\leq6) = 0.73$ and the high multiplicity data is $\varepsilon(m>6) = 0.45$.

If the τ events have a different multiplicity distribution, *e.g.* a higher average multiplicity, then one should not use the integrated value for ε. The mean multiplicity for MC tau events is 4.90. For tau events, 23% of the vertices have $m > 6$ (instead of 20% for the nominal sample). Therefore, the estimated location efficiency for the tau events is

$$(0.77)\,(0.73) + (0.23)\,(0.45) = 0.66$$

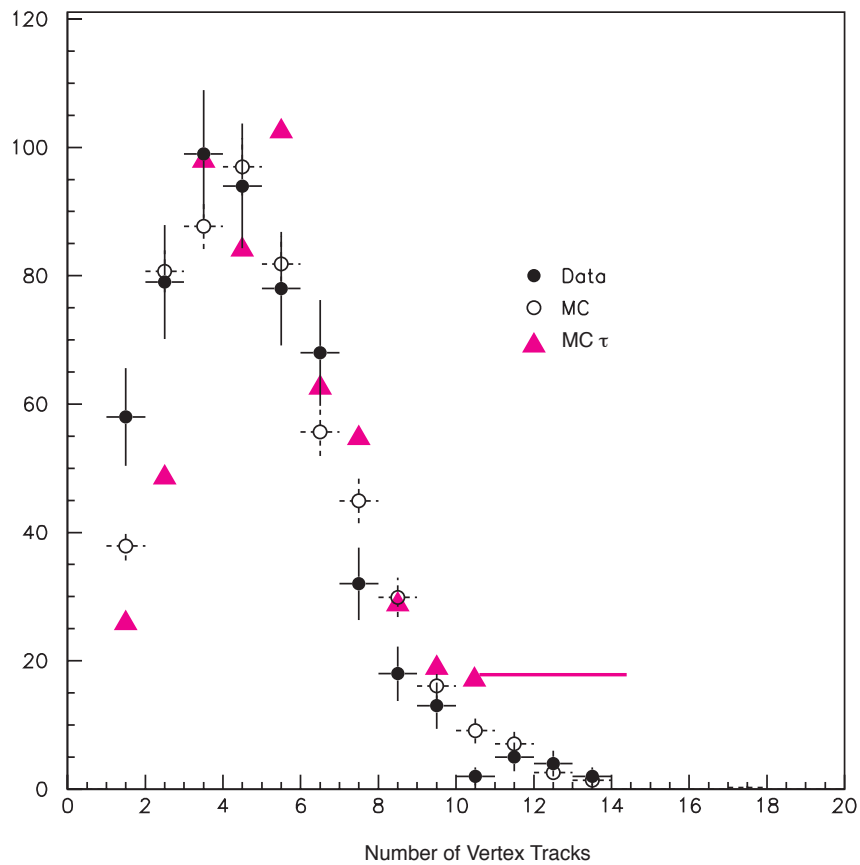This difference, 0.67 compared to 0.66, is probably small enough to ignore.

Figure 1. Multiplicity distribution of data and Monte Carlo. The number of MC events is normalized to the number of data (552) for total sample (open circles) and tau events (magenta triangles).